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SOME NOTES ON THE GEOLOGICAL HISTORY OF THE PARASITIC HYMENOPTERA.*

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PART I. GENERAL CONSIDERATIONS.

The occurrence in considerable abundance of fossil parasitic Hymenoptera in the deposits of the early and middle Tertiary has long been known, but it is only quite recently that they have received close attention. As early as 1849, in his classical work on the fossil insects of the Radoboj (Lower Miocene) and Oeningen (Upper Miocene) deposits, Heer ('47) described a considerable number of species belonging to these families, but this was before the classification of recent forms had been well worked out, and on this account his results are unsatisfactory from a more modern standpoint. The very rich fauna of Baltic amber (Lower Oligocene) was the subject of a brief note by Brischke ('86) where the occurrence of a number of recent genera in amber was recorded. I have lately had the opportunity to examine a small collection from the same source and have been able to detect a considerable series additional to those seen by Brischke. In America there is a very rich fauna of parasitic Hymenoptera preserved in the Miocene shales of an old Tertiary lake

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basin near Florissant, Colorado, and from these many genera have been taken which have been lately described (Cockerell, '06, and Brues '06, '10). These two sources taken together have already afforded such a considerable number of types that it is now possible to draw from the accumulated data some general conclusions regarding the phylogeny and geological history of certain components of this most interesting series of insects. Although necessarily quite incomplete and of a tentative nature, these have a bearing on the relationship of recent faunæ and are of both theoretical and practical interest, more particularly in view of the recent great advances made in the utilization of parasitic insects in combating injurious species.

The following list, compiled both from the literature and from unpublished observations, includes all the accurate determinations of genera relating to the parasitic Hymenoptera of Baltic amber and of the Miocene shales of Florissant. To facilitate a comparison of the two faunæ, they have been placed in parallel columns, with the corresponding families in juxtaposition.

GENERA OCCURRING IN BALTIC AMBER AND AT FLORISSANT.*

Baltic Amber.

Florissant Shales.

BETHYLIDÆ.

Sicrola.

Epyris.

Parasicrola.

Epyris.

Bethylinæ gen. nov.

Dryinus.

Chelogynus.

Dryininæ gen. nov.

PROCTOTRYPIDÆ.

Proctotrypes.

Proctotrypes.

BELYTIDÆ.

Several genera.

Pantocilis.

Belyta.

DIAPRIIDÆ.

One genus.

‡*Galesimorpha*.

* Names preceded by an asterisk (*) have been previously found by other observers, those preceded by a dagger (†) have not been seen fossil by the writer and those preceded by a double dagger (‡) are those of extinct genera.

CERAPHRONIDÆ.

**Ceraphron*.

SCELIONIDÆ.

**Hadronotus*.

CYNIPOIDEA.

†*Cynips*.*Figites*.†*Diastrophus*.*Andricus*.

Several genera.

‡*Protoibalia*.

AGAONIDÆ.

Tetrapus.

TORYMIDÆ.

Monodontomerus.*Torymus*.‡*Palæotorymus*.*Ormyrodes*.**Chalcis*.*Spilochalcis*.

EURYTOMIDÆ.

†*Dccatoma*.*Eurytoma*.

PERILAMPIDÆ.

†*Perilampus*.

CLEONYMIDÆ.

Cleonymus.

PTEROMALIDÆ.

†*Pteromalus*.*Pteromalus*.

One genus.

MYMARIDÆ.

†*Eustochus*.†*Anaphes*.†*Gonatocerus*.†*Limacis*.†*Litus*.†*Malfattia*.†*Palæomymar*.

EVANIIDÆ.

†*Evania*.*Aulacus*.†*Brachygaster*.*Pristaulacus*.*Oleisopriester*.*Aulacus*.

ICHNEUMONIDÆ.

ICHNEUMONINÆ.

Ichneumon*.*Trogus*.Ichneumon*.

CRYPTINÆ.

†*Phygadeuon*.*Phygadeuon*.†*Hemiteles*.*Hemiteles*.†*Pezomachus*.*Cryptus*.**Cryptus*.*Mesostenus*.

Several other genera.

PIMPLINÆ.

Lampronota.*Acænites*.†*Pimpla*.*Leptobatopsis*.*Lampronota*.*Glypta*.*Polysphincta*.*Pimpla*.*Xylonomus*.

TRYPHONINÆ.

Mesoleptus*.*Mesoleptus*.Tryphon*.*Tryphon*.†*Bassus*.*Orthocentrus*.*Camerotops*.*Exochus*.*Tylecomnus*.

OPHIONINÆ.

Astiphronma.‡*Protohellwigia*.†*Mesochorus*.*Labrorychus*.**Porizon*.*Anomalon*.*Barylypa*.*Exochilum*.‡*Hiator*.*Limmerium*.*Absyrtus*.*Parabates*.? *Ophclites*.*Lapton*.*Extastes*.*Mesochorus*.

		<i>Porizon.</i>
		<i>Dcmophorus.</i>
	ALYSIIDÆ.	
		<i>Alysia.</i>
	BRACONIDÆ.	
	EUPHORINÆ.	
		<i>Euphorus.</i>
	METEORINÆ.	
<i>*Mcteorus.</i>		
	MACROCENTRINÆ.	
† <i>Macrocentrus.</i>		
<i>Microtypus.</i>		
	HELCONINÆ.	
		<i>Diospilus.</i>
		<i>Dyscolctes.</i>
	BLACINÆ.	
<i>Blacus.</i>		
<i>Brachistes.</i>		
	SIGALPHINÆ.	
		<i>Calyptus.</i>
		<i>Urosigalphus.</i>
	CHELONINÆ.	
<i>*Ascogaster.</i>		
<i>*Chelonus.</i>		<i>Chclonus.</i>
	AGATHIDINÆ.	
		AGATHIS.
	MICROGASTERINÆ.	
		<i>Microgaster.</i>
		<i>Microplitis.</i>
		<i>Oligoneuroides.</i>
	OPIINÆ.	
<i>Diachasma.</i>		
	BRACONINÆ.	
† <i>Bracon.</i>		
	RHOGADINÆ.	
<i>Ischiogonus.</i>		
		<i>Exothecus.</i>
		<i>Rhogas.</i>
	STEPHANIDÆ.	
		† <i>Protostephanus.</i>

A casual examination of this tabular arrangement reveals the fact that about an equal number of genera are so far known from Baltic amber and from Florissant. This total is, however, a very poor means of comparison, for the greatest diversity exists in the representation of the individual families and groups. This is in part readily accounted for by the different way in which the insects have been entrapped previous to fossilization. As is well known, only such species occur in amber as have come in contact with the trunks of the trees bearing the sticky resin destined to become fossilized as amber. This at once exercised a selection with regard to certain groups which normally frequent such places and would appear to account for the presence of so many genera belonging to the Bethyridæ. Some such forms live in galls, others are parasitic on wood-boring beetles, still others on leaf-hoppers, etc., which would have brought them in proximity to the resin upon the trees. Other forms like Mymaridæ are so delicate and fragile that we can scarcely hope ever to find their remains in petrified form, although the beautiful preservation afforded by amber has made it possible to identify many species imbedded in this medium. This family so abundant in amber is, therefore, entirely absent in the Florissant shales. Aside from the poorer preservation of the Florissant material, the different way in which it has been laid down has resulted in the selection of quite a different component of the then existing fauna from that which appears in amber. The types occurring at Florissant are almost exclusively actively flying forms or others which live in proximity to bodies of water, since these deposits contain the remains of insects which had either flown into the waters of the original Florissant lake or one of its tributaries, or had possibly been engulfed in volcanic ash with which they were transported thither by streams. In some groups of Hymenoptera like the ants (Wheeler, '08) this has resulted in mutually excluding from the amber and florissant beds in great part that which occurs in the other. Thus, chiefly the workers of arboreal species occur in amber, while with few exceptions only winged forms are found in the Florissant deposits.

With the parasitic Hymenoptera, this is, however, not generally the case in families like the Ichneumonidæ, Braconidæ, Evaniidæ and the Proctotrypoidea, as is shown by the contents of the foregoing

table, and these groups can be quite satisfactorily compared, both with each other and with recent faunæ. In such a comparison, the most striking fact which attracts one's attention is the predominance of recent genera both in amber and at Florissant. Wheeler ('08) has summarized the ratio of living to extinct genera of ants known from Baltic amber and finds it to be in the proportion of 24 living to 11 extinct genera among a total of 35. The ratio of living to extinct genera of parasitic Hymenoptera in this amber has not yet been thus accurately determined, but there can be no doubt that it is much larger in favor of the recent ones. The same preponderance of modern genera is characteristic of the Florissant shales which have been more extensively studied, for here there are 63 living compared to 6 extinct genera among the parasitic families. The only conclusion to be reached from these data is that such types must be more conservative than the ants in the development of new generic types in spite of the complicated relations which they bear to their hosts. The very recent discoveries of so many most extraordinary and unexpected adaptations in the development and ethological relations of parasitic groups makes this still more remarkable for we should naturally look for correlations between such an enormous ethological plasticity and the morphological characters associated with it. It would appear that the logical conclusion to be drawn from such facts is that the adaptations in habits known to exist in recent species must be well fixed and were also present at least in a very similar form in Oligocene and Miocene species, which suggests that all attempts to trace the phylogeny of the larger groups must be pushed far into pre-Tertiary time. This same conclusion has been reached by other students of fossil insects of the more specialized orders and it seems well nigh hopeless in the present state of knowledge to attempt any generalizations concerning the phylogeny of the larger groups of Hymenoptera from paleontological data alone. Facts bearing on the occurrence and relationships of pre-Tertiary Hymenoptera are extremely meager, although the living families and genera appear suddenly in early Tertiary (Oligocene) times in nearly the same proportion as they do at present.

The most recent attempt to trace the origin of the parasitic Hymenoptera is that of Handlirsch ('08) who falls back mainly on pale-

ontology for the support of his conclusions. He would derive the group as follows: "The first forms with an elongated ovipositor may have come from Pseudosiricidæ which no longer laid their eggs in wood, but in the eggs of beetles occurring in the wood (Buprestidæ already existed). Thus the first parasitic Hymenoptera may have arisen, to which the Ephialtitidæ, still so poorly known, may belong." From these parasitic forms he would then derive the aculeates, digger wasps and bees. He considers further that the Ichneumonidæ are the most primitive of the various parasitic families, and that among these the Pimplinæ are the least specialized. The Braconidæ, Chalcidoidea, Proctotrypoidea, Evaniidæ and Stephanidæ he believes to be highly specialized forms.

As Handlirsch himself seems to appreciate, there are many difficulties in the way of this interpretation, and I believe that it will have to be fundamentally altered. In the first place the derivation of the Tertiary forms from *Ephialtites*-like insects rests upon a very slender basis. The problematic genus *Ephialtites*, resembling a Braconid or Torymid is the only member of the higher Hymenoptera as yet to be found in the Jurassic (Malm), and its perhaps accidental discovery there in nowise involves the probability of its being a primitive type; indeed the wonderful development of the parasitic Hymenoptera in the early Tertiary where they so closely simulated recent forms would lead us to believe that *Ephialtites* must be only one of many earlier types occurring contemporaneously, but remaining still unearthed by paleontologists.

The common occurrence of Jurassic Siricoid forms is however well authenticated and in combination with the primitive morphological characters of the recent Siricidæ and allied families gives good ground for considering them allied to the ancestors of the higher Hymenoptera.

Among the families of parasitic Hymenoptera I am inclined to believe for several reasons that certain of the Evaniidæ are the most generalized and that they represent the most primitive group of parasitica still surviving. Although they occur with other families in both amber and at Florissant, it seems quite certain that they were more abundant then than at the present time. Thus from the Florissant shales I have described two species of Aulacinæ probably representing two different genera, and there occur in Baltic amber

at least four genera belonging both to the Aulacinæ and Evaniinæ. This proportion is much greater than would occur in a general collection of recent insects, so we may safely infer that the Evaniidæ were more abundant in Tertiary times than at the present day. From a morphological standpoint this family also appears to be more closely allied to the phytophagous hymenoptera in several respects. In the first place the costal cell of the front wing is preserved while it is absent in the Ichneumonidæ and Braconidæ, although present also in many other families. In the Aulacinæ at least the wings have a more complete and primitive venation than in the Ichneumonidæ, and than in most of the Braconidæ as well. The absence of the costal cell in the Ichneumonidæ would thus appear to exclude them at once from the line of descent of aculeate forms.

Of the Braconidæ and Ichneumonidæ, the former are much more nearly related to the Evaniidæ through forms like *Cænocelius* (*Aulacodes*) which has been variously placed by different writers in both families although it has been even considered by Cresson ('65) as more closely related to the Ichneumonidæ. On the other hand the small and peculiar family Stephanidæ bridges the gap between certain other Evaniidæ (Fœninæ) (Bradley, '08) and one of the groups of true Braconidæ (Spathiinæ). The Stephanidæ are further peculiar in having a horned structure of the head, recalling that of certain Oryssidæ, as has already been pointed out by Ashmead ('00), a character which gives additional evidence of their primitive character. Only a single Stephanid of dubious relationship, *Protostephanus*, has been found fossil, at Florissant (Cockerell, '06). This group of three families is therefore very evidently to be regarded as a natural association. The Ichneumonidæ however present more difficulties and I cannot subscribe to Handlirsch's opinion that they are more primitive than any of the families heretofore mentioned. Their wings, which are very constant in venation, always lack the costal vein present in the Evaniidæ and Stephanidæ, while the basal section of the cubital vein is invariably absent though normally present in other families. On the other hand they cannot be derived from the Braconidæ as known from any Tertiary genus on account of the presence of the second recurrent nervure, which is invariably absent in the Braconidæ. In other respects the two families are very similar and both must, I think, be derived from as yet unknown forms possessing common

characters of two recurrent nervures and a complete cubital vein. Such a type is represented by the genus *Lysiognatha* Ashmead ('95) but this form has the peculiar exodont mandibles of the Alysiidæ which on this account cannot be considered a part of the stem from which the Braconidæ and Ichneumonidæ have been derived, although I believe they represent an offshoot not far from it. In the Miocene at Florissant Alysiidæ occur apparently in about the same proportion as they do in recent times. There is one other remarkable type with exodont mandibles, *Vanhornia*, recently described by Crawford ('09), but its affinities are so problematic that it can hardly enter into the present discussion. So far the family Agriotypidæ has not been found fossil, and any conclusions regarding its relationships must be derived from taxonomic studies alone.

Several families of the Proctotrypoidea have been discovered fossil, the Proctotrypodæ, Belytidæ, Diapriidæ, Ceraphronidæ and Scelionidæ, but with one exception all the genera are apparently identical with recent ones and none give any clue to the probable origin of the group.

The same is true of the Cynipoidea, with the exception of one genus *Protoibalia* (Brues, '10) from the Miocene shales of Florissant which shows characters transitional from the genuine Cynipids to the Ibalinæ.

Although the paleontological evidence concerning the origin of the foregoing families is scant it leads to a few general conclusions and they agree well with those derived from anatomical studies of the same families.

There is another family, the Bethylidæ, well represented in amber by some genera, which, taken in connection with a number of recent ones, indicate very nicely part of the line of evolution within this group.

It is a generally accepted fact that the older and more stable groups of animals, particularly those which are decadent from a paleontological standpoint, are the least adaptive, while those at present on the ascendent are better fitted to survive and prosper under changed conditions of environment.

The importance of this principle to the economic entomologist is at once apparent in connection with all attempts to introduce and naturalize parasitic insects with a view toward checking the increase

of injurious species, and its application to various parasitic types is of value in presaging the feasibility of introducing certain types. With reference to the insects under consideration the Evaniidæ and Stephanidæ appear as the most unlikely forms to adapt themselves to a changed environment, and of the two much larger related families, the Braconidæ and Ichneumonidæ, the former is for at least one reason the less promising. As I have pointed out in a previous paper ('10), it gives evidence of having been more abundant in the past, thus representing a somewhat decadent type. Among the several divisions of the Ichneumonidæ, the Pimplinæ appear to be decreasing in abundance although there is no doubt that some recent species are very plastic to judge from their adaptation to a large series of quite different host species. The Ophioninæ were very abundant in the Miocene and have materially decreased in number since that time, while the Ichneumoninæ, Cryptinæ and Tryphoninæ show no decrease. Prototrypoidea are not on the ascendent, but Chalcidoidea and Cynipoidea appear to be very markedly so, and the increasing abundance of the chalcidoids, in connection with their ability for rapid increase, suggests them as eminently suitable for experimental introduction.

Another factor entering into the practical use of parasitic species is the general character of the present faunæ of the various geographical regions, and a mention of the slight paleontological evidence bearing on this matter may not be amiss. It must, however, be borne in mind that a more complete knowledge of fossil insects might easily reverse conclusions drawn from such necessarily fragmentary data. The presence of Indo-Australian types in Baltic amber of Oligocene age has been recently noted by Wheeler ('08) among ants, and I have recognized the same tendency among parasitic Hymenoptera, so that at least some of the present types of this region show a primitive or synthetic character and we should not expect to find them adaptive. This is of course merely a repetition of conditions long known to exist in the vertebrate fauna of this region. Besides this rather positive evidence entomology can at present offer nothing in this line additional to what has been discovered from the investigation of the higher groups of animals.

PART II. THE PALEONTOLOGICAL DEVELOPMENT OF THE BETHYLIDÆ.

The family Bethylidæ was first segregated and defined by Haliday ('39) who considered it as forming a part of the fossorial Hymenoptera. It was, however, later removed by Westwood ('40) from this position and assigned to a place among the Proctotrypidæ of which he believed it to represent a subfamily of equivalent rank to the Ceraphroninæ, Scelioninæ, etc., which are now generally regarded as distinct families of the Proctotrypoid series. In his earlier writings Ashmead following Westwood included it as the subfamily Bethylinæ in his Monograph of the North American Proctotrypidæ ('93). He later, however, recognized its fossorial affinities and removed it to his superfamily Vespoidea where it stands as a distinct family in his classification of this group published in the Canadian Entomologist for 1902. In this paper he gives the following condensed account of his position in regard to the group: "I am now convinced that Haliday was right that these insects are allied to the fossorial wasps, and have nothing to do with genuine Prototrypoids; they are clearly allied to the Chrysididæ, through the Cleptinæ and Amesiginæ, and to the Sapygidæ, Tiphidæ, Cosilidæ, Thynnidæ, Myrmosidæ and Mutillidæ, all parasitic families." It is thus clear that he considered their affinities quite varied, including so many families as allied with them. It is quite evident that his mention of the Chrysididæ refers to the genus *Pristocera* and its allies which show unmistakable resemblances to that family, while the Sapygid and Tiphid affinities were no doubt based on *Epyris* and its allies, and those with the Thynnidæ and Myrmosidæ probably on *Dryinus*, *Pedinomma*, etc.

Since that time, one group regarded by Ashmead as a subfamily has been separated from the Bethylidæ, by Perkins ('05) and Kieffer ('07) as the Dryinidæ, but otherwise the group has remained intact.

For some reason, possibly on account of their small size and not very abundant occurrence in collections, these insects have not received much attention in recent years until very lately, with the exception of Ashmead's previously cited work ('93). With the discovery that some species of *Gonatopus* and related forms are important parasites of the leaf-hoppers injurious to sugar cane, this part of the group has quite lately attracted more attention and a considerable number of species have been described by Perkins ('05) as well as by Kieffer, and several others. A considerable series

of new and aberrant genera have also been discovered which are referred to the family, so that during the past five or ten years our knowledge of the group has been greatly increased.

During this time it has become apparent that the group is of very heterogeneous composition and that it must include several series of forms which have been derived from different sources. Unfortunately a number of the genera are at present known only by their wingless or subapterous females which increases the difficulty of determining their affinities, since the wing venation is perhaps the most important single character so far discovered in defining the limits of many of the groups of Hymenoptera. Even in forms with wings, the neuration of these organs is much reduced or atrophied so that the primitive types from which they must have been derived are difficult of determination. With these important characters lacking, many forms exhibiting reduced neuration or atrophied wings have been included in the family on account of their similar appearance notwithstanding the possibility or even likelihood that such a condition is the result of convergence rather than an indication of real genetic relationship. On this account I have been led to attempt a study of the characters of some of the members of the family previously known, and, at the same time to present some conclusions derived from several genera, both recent and fossil which are here discussed for the first time.

The Bethylinæ are characterized by the elongate, flattened form of the head, 12-13-jointed antennæ, more or less elongate prothorax

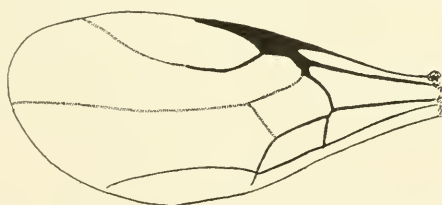


FIG. 1. *Palæobethylus longicollis* Brues MS.; wing.

and usually thickened legs. The wingless females in most cases have the thorax much constricted between the meso- and metathoracic segments. This group appears to be more closely related to the Ampulicidæ than to any other family of the fossorines and this relationship is very strongly shown by a peculiar genus which I have

lately discovered fossil in Baltic amber. In the fossil genus, which is unmistakably a Bethyloid, the prothorax is unusually long, like that of the Ampulicid *Rhinopsis*, and also bears a strong median longitudinal sulcus similar to that of *Rhinopsis*. The wing venation is considerably reduced (Fig. 1), but less so than in any living genus of the Bethylinæ and can be readily derived from the type of *Rhinopsis* by the suppression of the transverse cubital veins and the loss of the second recurrent nervure. The head has the same lenticular form and bears 13-jointed antennæ. The form of the mesothorax is very similar; it bears a second pair of lateral parapsidal furrows, and the size, form and sculpture of the metathorax is almost identical. The most striking difference is the absence of the well-developed abdominal petiole of *Rhinopsis* and the thickening of the legs, both Bethyline characters. From a close study of these two genera I feel convinced that the Bethylinæ, typified by *Epyris* and its allies have been derived from Ampulicidæ quite similar to *Rhinopsis*, and this opinion is further supported by the fact that the Ampulicidæ appear to be an old and archaic group.

Another part of the family, represented most typically by the genus *Pristocera* is, I think, also derived from an Ampulicid-like form, for it also shows unmistakable similarities to *Rhinopsis*. In the winged forms (males) of this group the loss of wing veins has proceeded a little farther than in the fossil genus above referred to; the legs have been less modified, remaining slender, and the thorax, except the prothoracic segment, is scarcely different from that of *Rhinopsis*. The prothorax has been much shortened, and the head, instead of becoming more elongate, is thickened and quadrate in form. The abdomen is less modified, being subpetiolate.

Probably the most easily defined and sharply circumscribed group of the Bethyloid series is the group variously regarded as a family or subfamily, represented by *Dryinus* and its allies. The fore tarsi of the females of this group are peculiarly modified into a chelate structure involving the terminal joint. This modification, which occurs in nearly all the genera, is so extraordinary and characteristic that it serves for their instant recognition. The form of the head and thorax of the members of this group is also very different from that of other Bethyloids although the wings and abdomen are quite similar. The legs in all genera have the coxæ and trochanters very elongate

and the femora strongly obclavately thickened. The chelate tarsi and the uniformly 10-jointed antennæ occur also in a number of fossil species belonging to several genera found in Baltic amber of Oligocene age, but in a new genus from Borneo, here described for the first time, the tarsi are simple as in two other known genera, and the antennæ are 12-jointed. While there can be no doubt that it is closely related to the Dryinidæ, it approaches in many respects certain Thynnids like *Methoca*, but I think this resemblance undoubtedly superficial and that the Dryinids have also been derived from an Ampulicid type.

Another interesting series forms the subfamily Emboleminæ of Ashmead which he places between the Bethylinæ and Dryininæ ('02). Of this group the rare genus *Ampulicimorpha* Ashm. from western North America appears to be the most generalized form yet discovered (Fig. 2). As its name suggests it bears a striking resemb-



FIG. 2. *Ampulicimorpha confusa* Ashm.; wing.

lance to the Ampulicidæ also. In spite of this, however, it really shows less similarity to this family than the types previously discussed. The antennæ are 13-jointed, inserted high up on the front, and the form of the metathorax is very much like that of *Proctotrypes* and its allies. This has already been mentioned by Perkins ('05) who writes: "To me the Dryinidæ together with the small and little known subfamily Emboleminæ of Ashmead (which may probably be merged in one or the other of these) [Dryinidæ or Bethylinæ] constitute a natural group, synthetic between the old Fossorial series of the Aculeata and the true Proctotrypidæ." From a study of *Ampulicimorpha* I have been led to the same conclusion with respect to the relationship of *Ampulicimorpha* and the Proctotrypidæ, but as can be seen from the preceding discussion, not in regard to the Bethylinidæ in general. With the exception of the wings, which have a very much degenerated venation in the Proctotrypidæ, the resemblance is very strong, even to the armature of the male genitalia by a pair of spines in both, and I regard *Ampulicimorpha* as a remnant of a group

from which the Proctotrypidæ have evolved, and thus well removed from the Bethylidæ.

There is still another group which forms a discordant element in the Bethylidæ, the tribe Sclerogibbini, widely distributed but represented so far as known by only a few rare genera. Of one of these, *Mystrocnemis* Kieffer, I have had the opportunity to study a species from Cape Colony recently described (Brues, '06). The group is characterized by extraordinary multiarticulate antennæ, greatly thickened legs, and in some genera by a very peculiarly formed head. The antennæ must undoubtedly be secondarily modified, for no other family except the Trigonalidæ resembling these insects in any way possesses antennæ of this sort, and the same must apply to the head. I suspect that the genus *Algoa* (Fig. 4) here described is related to this group, and as it furthermore shows strong Tiphiiid and Cosilid affinities, I believe that *Mystrocnemis* and its allies are derivatives of the group from which the recent Tiphiiidæ and Cosilidæ have come. The confirmation of this must, however, await further discoveries.

From the foregoing, it appears that the old family Bethylidæ must be regarded as a very unnatural assemblage, and in the appended table I have attempted to suggest a more acceptable arrangement of its components.

BETHYLIDÆ (including the Bethylini of Ashmead, derived from Ampulicid-like forms).

Bethylinæ.

Pristocerinæ.

DRYINIDÆ (including *Dryinus* and its allies, derived from Ampulicid-like forms).

EMBOLEMIDÆ (an ancient group related to the forms from which the Proctotrypidæ are descended).

?SCLEROGIBBIDÆ (a group related to the Tiphiiidæ and Cosilidæ).

PART. III. DESCRIPTION OF NEW GENERA AND SPECIES.

DRYINOPSIS, new genus.

Female.—Wingless. Thorax trilobed, the pro-, meso- and metathoracic segments being sharply separated. Head large, twice as wide as the thorax, much narrowed behind the eyes, and about twice as wide as thick; posteriorly sharply margined. Vertex convex, front concave above the antennæ, and below

on each side with a deep depression for the reception of each scape. Eyes large, pubescent; ocelli large and close together. Mandibles large, bidentate. Antennæ 12-jointed, stout, only about twice as long as the head-height; scape stout, as long as the two following joints together; pedicel one half as long as the first flagellar joint; following, except the last, becoming shorter and thicker, the seventh and eighth about quadrate. Maxillary palpi 5-jointed, long and slender; labials 3-jointed. Pronotum narrowed both behind and in front, just before the anterior margin with a transverse groove or constriction. Mesothorax cylindrical, stalk-like in front. Metathorax widened and globose behind. Abdomen with a short, but distinct petiole. Legs as usual, the femora slightly thickened. Anterior tarsi simple, not chelate.

***Dryinopsis simplicipes*, new species.** (Fig. 3.)

Female.—Length 5 mm. Entirely shining black, covered with sparse, long, glistening white hairs; only the first two joints of the antennæ, the palpi, the tips of the trochanters, tarsi, and apex of abdomen reddish or ferruginous. Head polished, smooth on the vertex, sparsely punctate behind the eyes; cheeks smooth. Front with an impressed line descending from the anterior ocellus, which passes over into a carinate elevation above the base of the antennæ, separating the antennal fovea. Antennæ inserted far down on the face, on a level with the base of the mandibles. Clypeus small, convex. Pronotum smooth, except for the crenulate furrow in front and a shagreened sculpture anterior to this. Mesothorax closely longitudinally striate or fluted anteriorly on the stalked portion. Metathorax entirely smooth, a little longer than the mesothorax. Petiole one third longer than wide at the apex. Second and

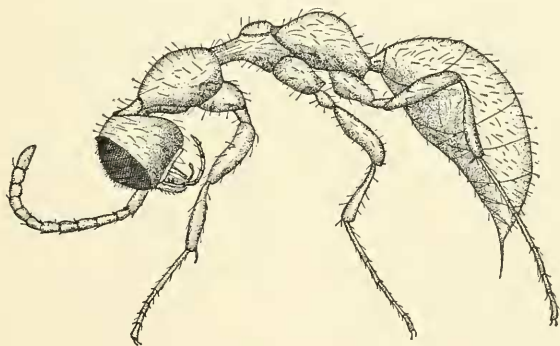


FIG. 3. *Dryinopsis simplicipes*, new species; female.

third segments of nearly equal length, following growing shorter. Front tarsi simple, the first joint nearly as long as the following together. All femora obclavate; tarsal claws each with a single tooth.

Described from a specimen collected by E. B. Keeshaw at Samut Api on the west coast of British North Borneo.

This is a typical Dryinid, much resembling *Gonatopus*, but differing from this genus and its allies by the simple fore tarsi of the female. From other Dryinidæ it differs by the 12-jointed antennæ.

ALGOA, new genus.

Female.—Entirely apterous, elongate, thorax constricted medially. Head seen from above one half wider than thick antero-posteriorly but thin above, the front sloping back sharply above the antennæ which are inserted close together in lateral depressions just above the clypeus; 12-jointed, simple, short, thinner apically. Eyes bare, small, very elongate, over twice as long as broad, separated by their width from the vertex and from the base of the mandibles. Mandibles long, acute, widely separated at the base, with three microscopic teeth on the inner side at the tip. Maxillary palpi 6-jointed; first joint very short, third with a spine at its tip. Labial palpi 4-jointed. Cheeks and temples margined behind, the head concave posteriorly inside the margin. Thorax narrowed medially, widened out both in front and behind, prothorax as long as the mesonotum and metanotum together. Mesonotum very short, medially elevated, with two foveate, indistinct furrows. Metanotum wider behind, arcuately excised, with the hind angles produced and the posterior surface concave. Abdomen as long as the thorax, with six segments of which the second is the longest, distinctly constricted at the base of the second segment both above and below. Legs stout, smooth, the anterior femora especially large and swollen.

Algoa heterodoxa, new species. (Fig. 4.)

Female.—Length 2.5–5.2 mm. Piceous, the basal three joints of the antennæ, the mandibles and the legs, except the base of the coxæ and all the femora much lighter, yellowish-brown. Head highly polished, not punctate, ocelli visible in certain lights as faint dots arranged in a large triangle. Scape of antennæ as long as the first flagellar joint; pedicel two thirds as long; second flagellar joint three fourths as long, following of about equal length, but growing thinner. Thorax brownish pubescent except on the pro- and mesopleuræ, not sculptured, metanotum behind with a marginal carina. Abdomen brownish pubescent, sessile; first segment with its declivous basal portion separated by a carina; second segment as long as wide, more than twice as long as the first and equal to the following three taken together; third to fifth gradually shorter. Tibial spurs 1, 2, 2. Hind legs moderately stout, the tibiæ smooth; middle legs with the femora swollen; those of the anterior legs enormously enlarged, obovate. Fore tarsi one half longer than their tibiæ; those of the other legs nearly twice as long.

Described from four specimens collected by Dr. Hans Brauns at Algoa Bay, Cape Colony, during December and April.

This remarkable species is of doubtful relationship but has strong affinities with the *Sclerogibbini*, for the thorax, abdomen and legs

are very similar to those of *Mystrocnemis*. On the other hand it shows many resemblances to certain Pompilidæ of the group Homonotini, but differs in having a very strong ventral constriction between

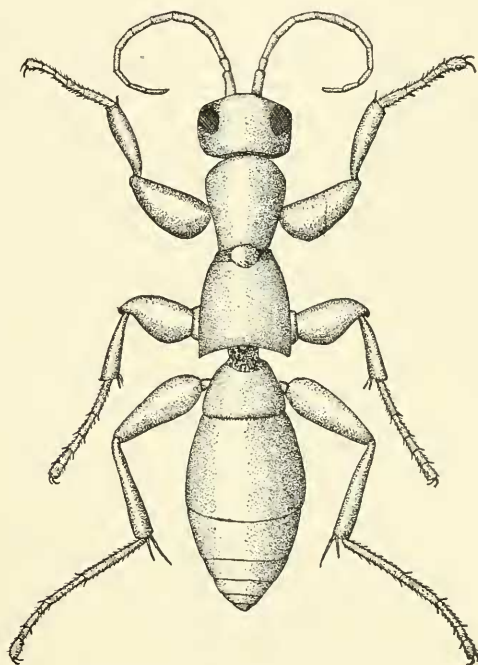


FIG. 4. *Algoa heterodoxa*, new species; female.

the first and second segments like certain Cosilidæ (*Sicrolomorpha*) which it also approaches in the form of the head showing a connection between *Mystrocnemis* and its allies and the Cosilidæ.

***Parascleroderma nigra*, new species. (Fig. 5.)**

Female.—Length 2.3 mm. Black, with a bluish cast, especially on the head; scape and pedicel of antennæ honey yellow; basal four joints of flagellum and tarsi brownish. Head very flat, widest just behind the eyes where it is half as broad as long, slightly narrowed toward the rounded posterior angles; its upper surface shagreened. Eyes very small, oval, bare, placed near the lateral margin of the head, close to the anterior angles. Head just behind the insertion of each antenna with a rounded tubercle about the size of the eye, the space between these anteriorly regularly excavated. Antennæ 13-jointed, slender, scarcely twice the length of the head; scape elongate, thickened apically, as long as the four following joints. Pedicel a little longer than the

first flagellar joint, following growing barely longer and slightly thicker, the fourth about one half longer than wide. Prothorax widest just before the middle, sharply contracted anteriorly; posteriorly narrowed, with sharply dentate hind angles; above very convex; smooth, except at the posterior fifth

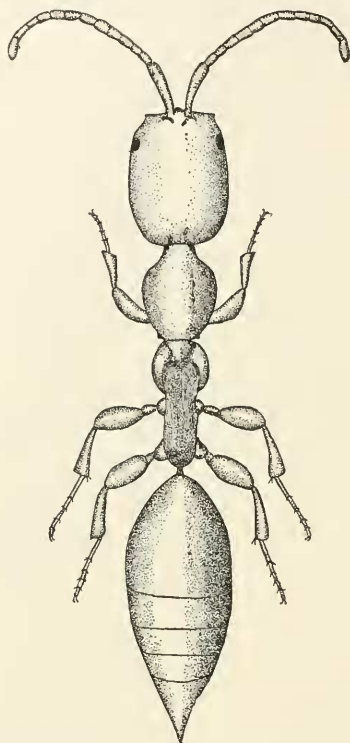


FIG. 5. *Parascleroderma nigra*, new species; female.

where it is punctulate or shagreened. Mesonotum short, narrow, convex, rugulose; the mesopleuræ visible from above as smooth convex crescentic pieces embracing the anterior angles and the base of the sides of the mesonotum, the latter elongate, with parallel sides, finely longitudinally aciculate, the lines curving toward the median line in front; posterior slope rugulose. Abdomen one fourth longer than the thorax, with a short, very slender petiole, second segment longer than the following three together; third to fifth subequal; following not clearly separated. Legs stout, the tibiæ all bare, not spinulose. Middle and posterior femora much thickened, broadest at the middle.

Described from a specimen collected by Dr. Hans Brauns at Bothaville, Orange Free State, May 5, 1899.

This resembles a *Pristocera* very closely, but belongs to *Parascleroderma* Kieffer which differs by the bare, non-spinulose tibiae.

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WESTCHESTER HETEROPTERA.—II. ADDITIONS, CORRECTIONS AND NEW RECORDS.

BY J. R. DE LA TORRE BUENO,

WHITE PLAINS, N. Y.

The *raison d'être* of this list is set forth in its predecessor. In this are given the fruits of the work of the season of 1909, including the winter of 1908-9. As will be seen, there are no less than 30 species added to those recorded last year, which brings the total up to 138 species for Westchester Co. When it is considered that Mr. E. P. Van Duzee's Buffalo list, the result of his collecting and that of others, yielded only 127 species for the families I enumerate, the present relation is not to be despised.

A number of corrections due to the ceaseless change of nomenclature have to be made. These will be noted in their proper places. The identification of forms of our fauna by means of the imperfect descriptions of the early hemipterists have saddled us at this day with a burden of misinformation which very fortunately is being reduced year by year by the labors, alas! not of our own, but of European entomologists. It appears to me a fundamental axiom that every entomologist, and very especially every hemipterist, before referring an American form to a genus peculiar to some other region of the globe, should make it his business to procure authenticated specimens of the type species of that genus. Then a careful comparison between the two forms should serve to settle the point